



LB11880

Three-Phase Sensorless Motor Driver with Loading Motor Driver

Overview

The LB11880 is a sensorless motor driver that also includes a loading motor driver. It is ideal for drum motor drive in VCR products.

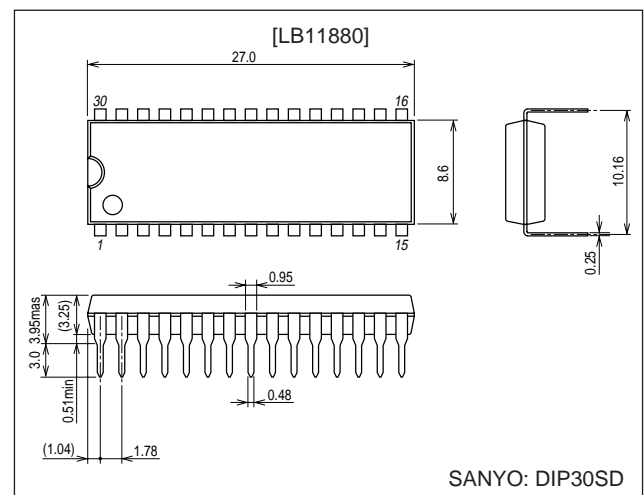
Functions and Features

- Soft switching drive
- No Hall sensors required
- No FG sensors required
- Built-in PG amplifier
- Built-in thermal shutdown circuit
- Current limiter circuit
- On-chip loading motor driver

Package Dimensions

unit: mm

3196A-DIP30SD



Specifications

Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage 1	$V_{CC\ max}$		14.5	V
Maximum supply voltage 2	$V_{CC\ L\ max}$		14.5	V
Maximum supply voltage 3	$V_{REG\ max}$		7.0	V
Output voltage	V_{omax}		14.5	V
Input voltage	$V_{I1\ max}$		-0.3 to $V_{REG} + 0.3$	V
Cylinder current	I_{omax}		1.0	A
Loading current	$I_{omax\ (AVE)}$		0.4	A
	$I_{omax\ (peak)}$		1.2	A
Allowable power dissipation	P_{dmax}	When mounted on the specified printed circuit board*	2.8	W
Operating temperature	T_{opr}		-20 to +75	$^\circ\text{C}$
Storage temperature	T_{stg}		-55 to +150	$^\circ\text{C}$

Note: * Specified printed circuit board: 114.3 × 76.1 × 1.6 mm glass-epoxy board

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Allowable Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage 1	V _{CC}		8 to 13.8	V
Supply voltage 2	V _{CCL}		8 to 13.8	V
Supply voltage 3	V _{REG}		4 to 6	V

Electrical Characteristics at Ta = 25°C, V_{CC} = V_{CCL} = 12 V, V_{REG} = 5 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply current 1	I _{CC}	VC = 0 V, XIN = YIN = 0 V		3.5	5.0	mA
Supply current 2	I _{CCL}	VC = 0 V, XIN = YIN = 0 V			1	mA
Supply current 3	I _{REG}	VC = 0 V, XIN = YIN = 0 V		10	15	mA
Output saturation voltage 1	V _{Osat1}	IO = 0.4 A, source + sink		1.4	2.0	V
Output saturation voltage 2	V _{Osat2}	IO = 0.8 A, source + sink		1.8	2.6	V
MC pin common-mode input voltage range	V _{IC}		0		V _{CC} - 2	V
VC pin input bias current	I _{VC}	VC = 0 V	-2	-1		μA
Control start voltage	V _{THVC}	V _{RF} = 10 mA	2.4	2.5	2.6	V
Closed-loop control gain	GM _{VC}	R _F = 0.5 Ω	0.75	0.95	1.15	A/V
PCOUT output current 1	I _{PCOU}	Source side		-90		μA
PCOUT output current 2	I _{PCOD}	Sink side		90		μA
VCOIN input current	I _{VCOIN}	VCOIN = 5 V		0.1	0.2	μA
Minimum VCO frequency	f _{VCO} MIN	CX = 0.022 μF, V _{COIN} = open		400		Hz
Maximum VCO frequency	f _{VCO} MAX	CX = 0.022 μF, V _{COIN} = 5 V		18.5		kHz
C1/C2 source current ratio	R _{SOURCE}	I _{C1SOURCE} /I _{C2SOURCE}	-12		+12	%
C1/C2 sink current ratio	R _{SINK}	I _{C1SINK} /I _{C2SINK}	-12		+12	%
C1 source/sink current ratio	RC1	I _{C1SOURCE} /I _{C1SINK}	-35		+15	%
C2 source/sink current ratio	RC2	I _{C2SOURCE} /I _{C2SINK}	-35		+15	%
Thermal shutdown operating temperature	T-TSD	*	150	180	210	°C
Thermal shutdown hysteresis	ΔTSD	*		15		°C

Note: * These values are design guarantee values, and are not tested.

FG/PG Amplifier Block at Ta = 25°C, V_{CC} = V_{CCL} = 12 V, V_{REG} = 5 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Back EMF FG]						
Output on voltage	V _{OL}				0.4	V
Output off voltage	V _{OH}		4.5			V
[PG Amplifier]						
Input offset voltage	V _{IO}		-8		+8	mV
Input bias current	I _{BIIN-}		-250			nA
Common-mode input voltage range	V _{ICOM}	*	1		3.5	V
Open-loop gain	G _{VPG}	f = 1 kHz		55		dB
Output on voltage	V _{OL}				0.4	V
Output off voltage	V _{OH}		4.5			V
Schmitt amplifier hysteresis	V _{Shys}		70	93	115	mV

Note: * These values are design guarantee values, and are not tested.

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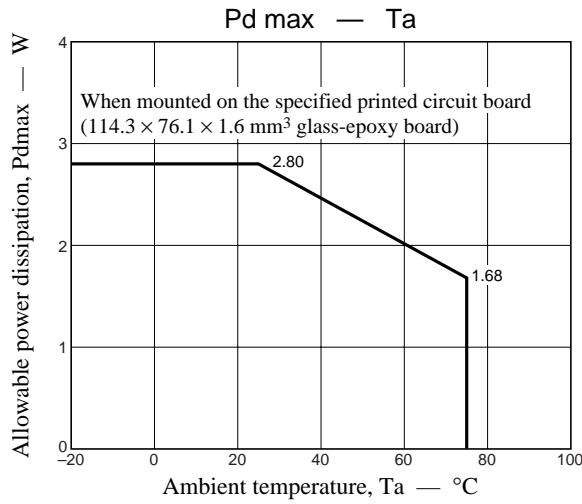
Loading Block at $T_a = 25^\circ\text{C}$, $V_{CC} = V_{CCL} = 12\text{ V}$, $V_{REG} = 5\text{ V}$

Parameter		Symbol	Conditions	Ratings			Unit
				min	typ	max	
Input voltage	1 (high)	V_{IN1}		3.5		5	V
	2 (low)	V_{IN2}		0		0.8	V
Input current		I_{IN}	Sink $V_{IN} = 3.5\text{ V}$		30	50	μA
Input hysteresis		ΔVT			0.7		V
Saturation voltage	$V_{sat\ U-1}$		$V_{ref} = VS$, between the output and VS $I_O = 0.2\text{ A}$, CW/CCW mode		1.5	2.1	V
	$V_{sat\ L-1}$		$V_{ref} = VS$, between the output and ground $I_O = 0.2\text{ A}$, CW/CCW mode		0.2	0.3	V
	$V_{sat\ U-1'}$		$V_{ref} = VS$, between the output and VS $I_O = 0.4\text{ A}$, CW/CCW mode		1.6	2.2	V
	$V_{sat\ L-1'}$		$V_{ref} = VS$, between the output and ground $I_O = 0.4\text{ A}$, CW/CCW mode		0.3	0.5	V
Upper side residual voltage	$V_{satU-1''}$		$V_{ref} = 8\text{ V}$, between the output and ground $I_O = 0.2\text{ A}$, CW/CCW mode	7.2	8.0	8.8	V
	$V_{satL-1''}$		$V_{ref} = 8\text{ V}$, between the output and ground $I_O = 0.4\text{ A}$, CW/CCW mode	7.2	8.0	8.8	V
Output transistor leakage current	Upper	ILU				50	μA
	Lower	ILL				50	μA
Diode forward voltage	Uper	VFU	$I_F = 0.4\text{ A}$		1.3		V
	Lower	VFL	$I_F = 0.4\text{ A}$		1.0		V
Control supply current		I_{ref}		-5	-2		μA

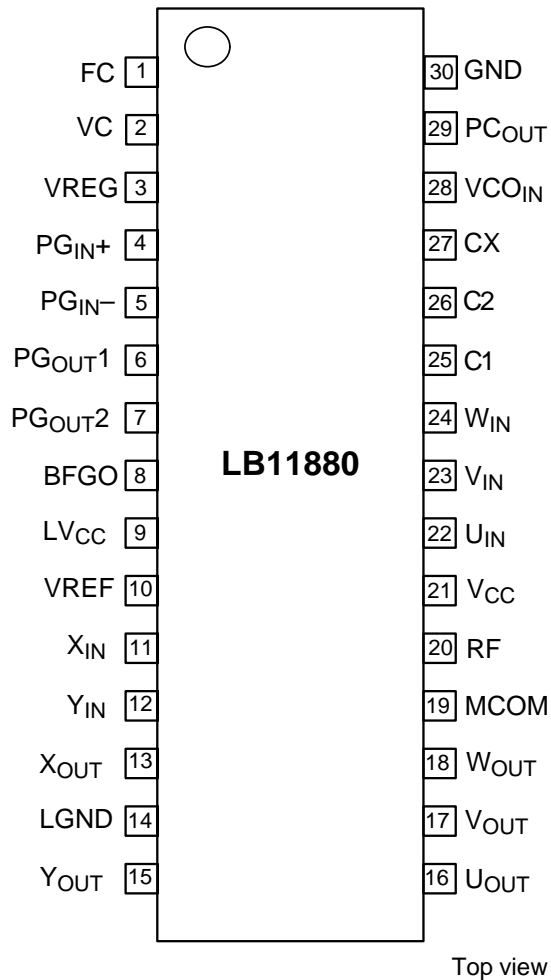
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Loading Motor Truth Table

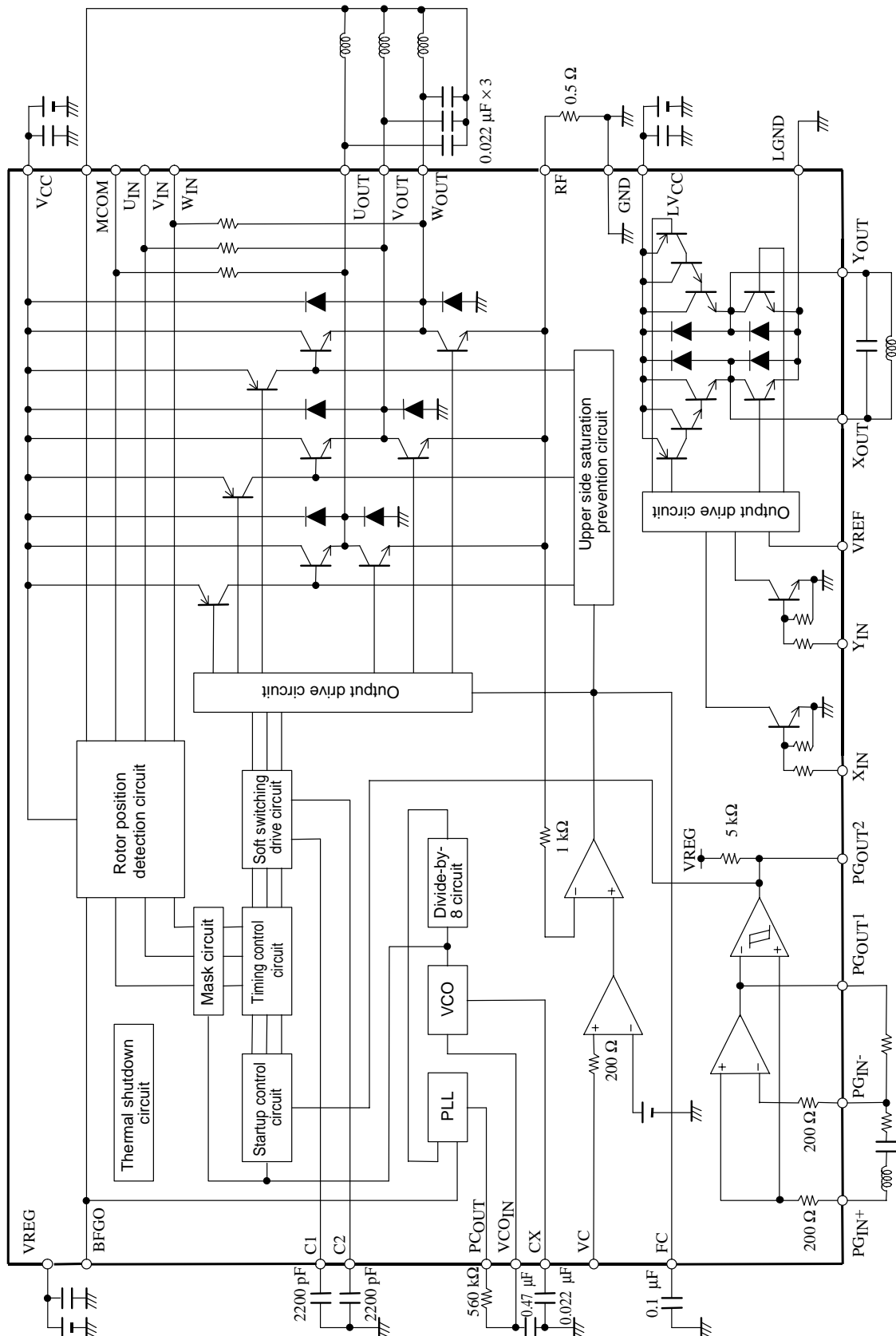
Input		Output		Mode
X _{IN}	Y _{IN}	X _{OUT}	Y _{OUT}	
L	L	Off	Off	Standby
H	L	H	L	Forward
L	H	L	H	Reverse
H	H	L	L	Brake



Pin Assignment



Block Diagram (Note that the values of the external components depend on the motor used.)



Pin Description

Pin No.	Pin	Pin voltage	Function	Equivalent circuit
1	FC		<p>Frequency characteristics compensation</p> <p>Oscillation in the current control system closed loop can be prevented by connecting a capacitor between this pin and ground.</p>	
2	VC	0 V to VREG	<p>Speed control</p> <p>This circuit implements constant-current control in which current feedback is applied from the RF system.</p>	
3	VREG	4 V to 6 V	<p>Control system power supply</p> <p>This power supply must be stabilized so that ripple and noise do not enter the IC.</p>	
4	PG _{IN+}		<p>PG amplifier plus side input</p> <p>This pin is biased to 1/2 VREG internally.</p>	
5	PG _{IN-}		<p>PG amplifier minus side input</p>	
6	PG _{OUT1}		<p>PG amplifier linear output</p>	

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Pin No.	Pin	Pin voltage	Function	Equivalent circuit
7	PG _{OUT2}		PG Schmitt amplifier output	
8	BFGO		Motor back EMF voltage detection FG output (synthesized from three phases)	
9	LV _{CC}	8 to 13.8 V	Loading motor driver output transistor power supply	
10	VREF	0 to V _{CC} L	Loading motor driver output voltage setting	
11	X _{IN}	0 V to VREG	Loading motor driver logic input	
12	Y _{IN}			
13	X _{OUT}		Loading motor driver output	
15	Y _{OUT}			
14	LGND		Loading motor driver output transistor ground	

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Pin No.	Pin	Pin voltage	Function	Equivalent circuit
16	U _{OUT}		Drum motor driver output	
17	V _{OUT}			
18	W _{OUT}			
20	RF	8 to 13.8 V	<p>Lowest potential of the drum motor driver output transistor</p> <p>This IC implements constant-current control by detecting this voltage.</p> <p>The current limiter also operates by detecting this voltage.</p>	
21	V _{CC}	8 to 13.8 V	Internal reference voltage and power supply for both the drum motor driver output block and the coil waveform detection circuit.	
19	MCOM		Motor coil center input	
22	U _{IN}		Coil waveform detection comparator input	
23	V _{IN}		Each phase output is connected by an internal 10 kΩ resistor.	
24	W _{IN}			
25	C1		Triangular wave generating capacitor connection	
26	C2		This triangular wave is used to implement soft switching in the coil output waveform.	
27	CX		<p>The value of the capacitor connected between this pin and ground determines the operating frequency range and the minimum operating frequency of the VCO circuit.</p>	

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Pin No.	Pin	Pin voltage	Function	Equivalent circuit
28	VCO _{IN}		VCO circuit voltage input The PCOUT pin voltage is filtered by an RC circuit and input to this pin.	
29	PC _{OUT}		VCO circuit PLL output	
30	GND		Ground for all circuits other than the drum and loading driver output transistors.	

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